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# Mobile Advertisement in Vehicular Ad-Hoc Networks

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# Outline

- Scope and motivation
- Architecture
- Mobile advertisement using access points
- Implementation details
- Experimental results
- Conclusions

# Scope and motivation

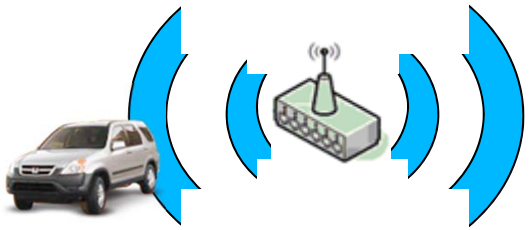
- Scenario: You arrived by car (London is a nice example). You're driving in a foreign city and are looking for information. The GPS navigator can provide you some data (mostly static). How about when you are looking for a restaurant, in your current area, serving vegetarian food… What do you do then?
- Scenario 1: Ask a friend and hope for the best… not yet there
- Scenario 2: Mobile ~~advertisement~~ to the rescue…

dissemination of data

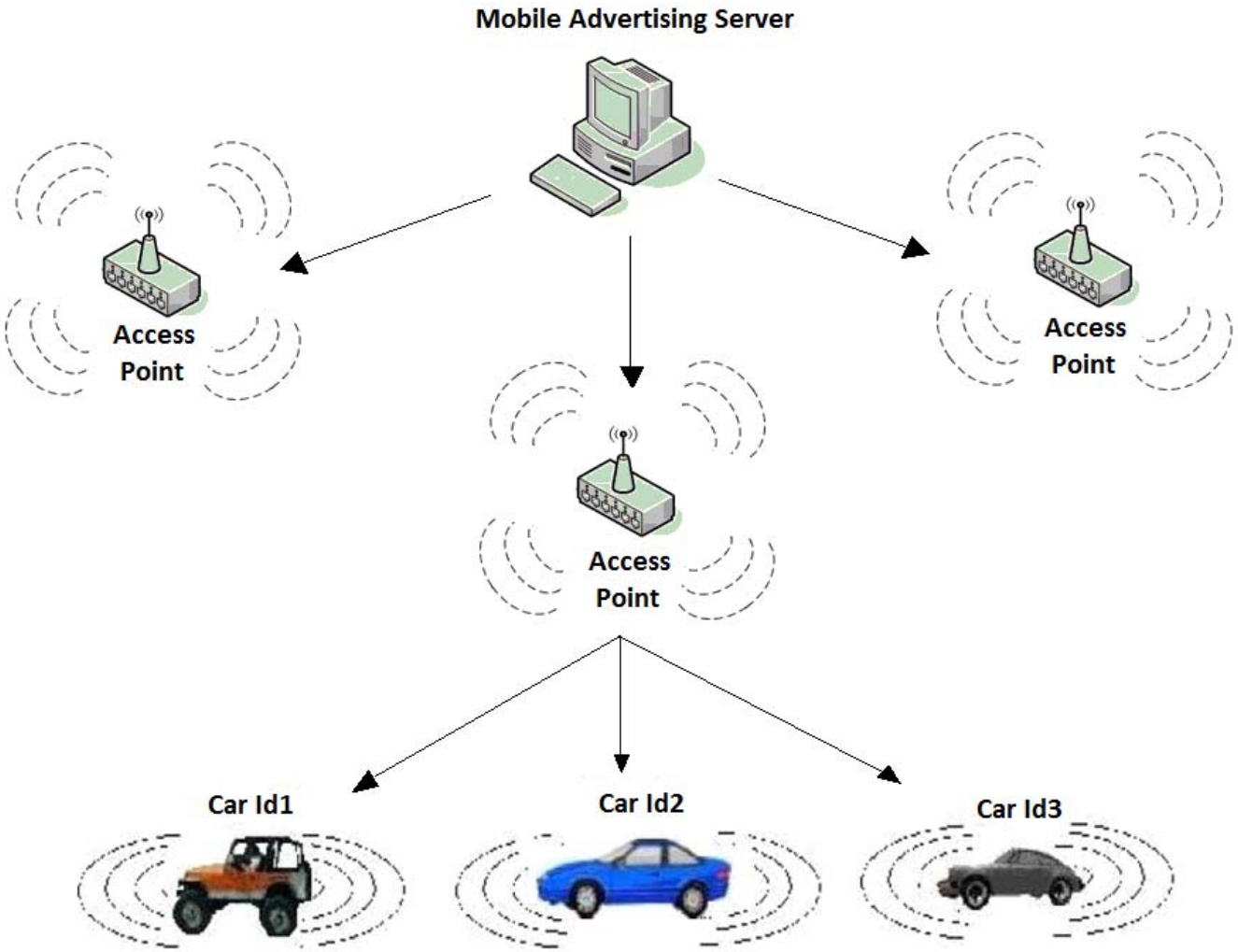
- We present a solution for the dissemination of information to interested drivers using ITS capabilities.
  - Incidents, announcements, virtual e-sticks, landmarks, etc.

# Proposed solution

- Mobile advertisement over VANETs - takes advantage of short-range wireless network communication for making recommendations based on *location-awareness*
  - Use APs as emitters
  - Send the message to all clients within wireless transmission range
  - Send same message repeatedly
- Design for/with Intelligent Transport Systems (ITS)
- Pros:
  - Signal locality.
  - Does not require modifications to existing wireless infrastructures.
  - Cheap technology.
  - The solution does not require a discovery phase
  - No protocol establishment – cars travel fast



# Architecture



# Possible implementation

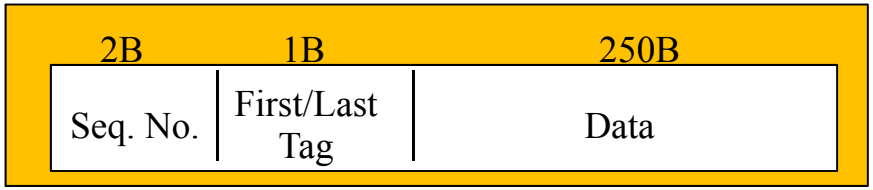
- Use of beacons to send information?
  - Does not require prior establishment of a network connection – advantage when working with speeding cars.
  - The messages are received by all clients within communication range.
  - A client can receive beacons from many APs simultaneously.
  - The client does not have to send anything back in return.
  - Low network traffic.
- Problems:
  - How to insert information into wireless beacons?
  - How much information can be carried?

# Possible implementation

- There are alternatives for inserting information into beacon (based on 802.11 protocols)
- SSID ( 32 bytes )
  - The name of the wireless network
  - Relatively easy to manipulate
  - Hard to differentiate between beacons carrying information and beacons carrying actual name of the AP.
- BSSID ( 6 bytes )
  - Unique identifier of the AP
  - Small size
- Vendor-Specific ( 253 bytes )
  - Data at the end of each beacon frame
  - Requires updating the AP's and Client's Operating System and Network Stack
  - Prototype solution: Android's stack

# Possible implementation

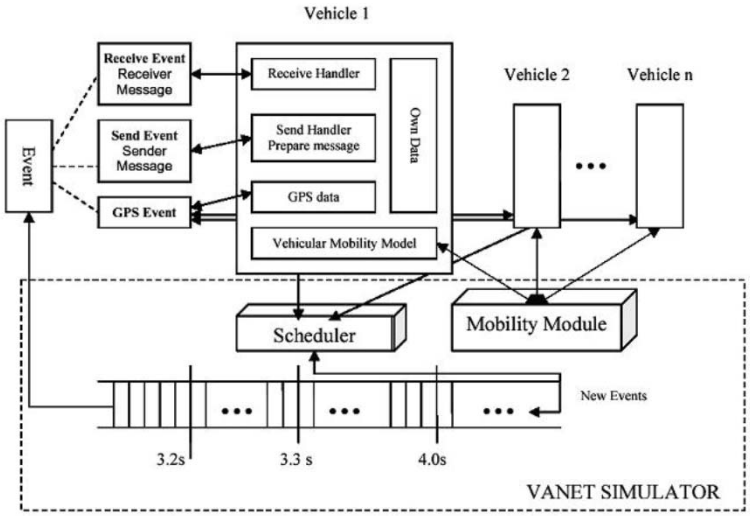
- Still - too little space for information.
- Solution: Message fragmentation.

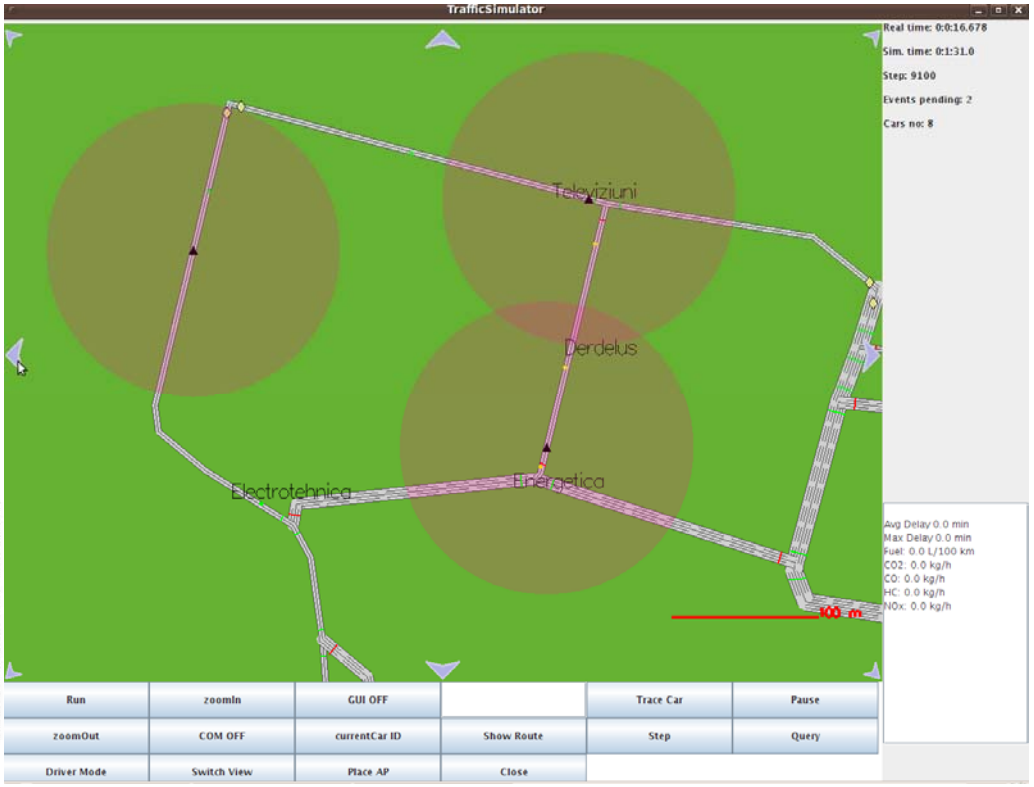



- Possible implementation:
- Wireless communication range for the AP : 90 m
- Speed of the vehicles: 50 km/h = 13.8 m/s
- Beacon Interval : 10 ms => 100 packets per second
- Time spent by vehicles within AP's wireless range:
  - 90 (m) / 13.8 (m/s) = 6.5 (s)
- Number of packages sent in this time interval:
  - 6.5 (s) * 100 (pkg/s) = 650 pachete
- Quantity of sent information:
  - 650 * 251 (bytes) ≈ 160 KB

# Experimental evaluation

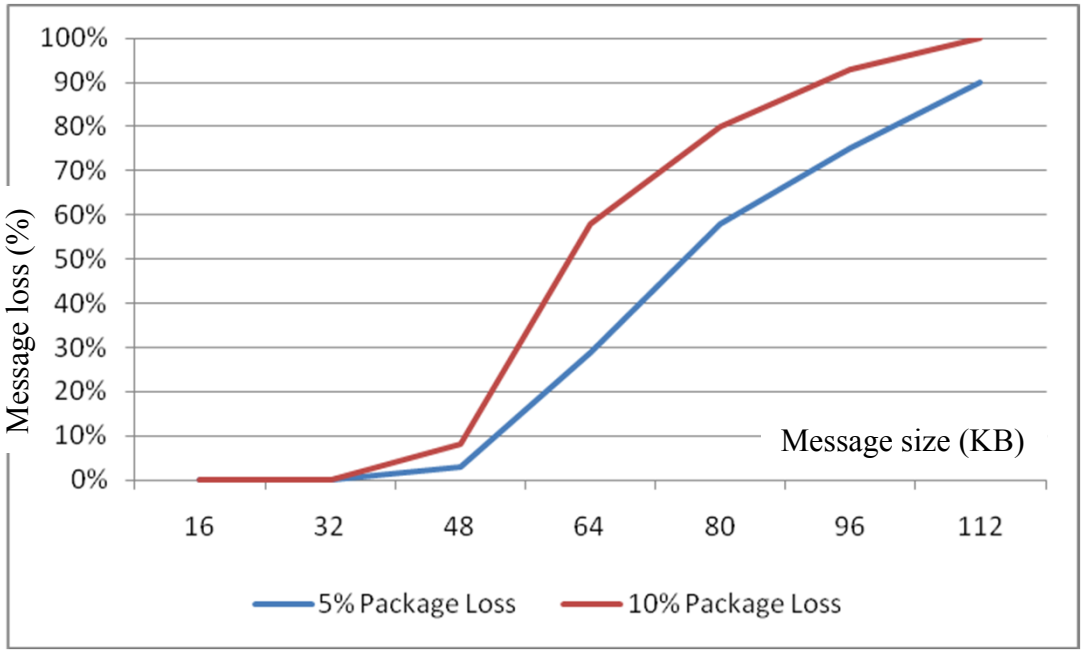
- Simulation implementation
- Maximum wireless transmission distance for APs: 90 m
- Beacon interval: 10 ms
- Speed of vehicles: 60-70 Km/h
- Probability of loosing packets: 5% ( Test1 ) | 10% ( Test2 )
- Size of the message:
  16KB – 112KB



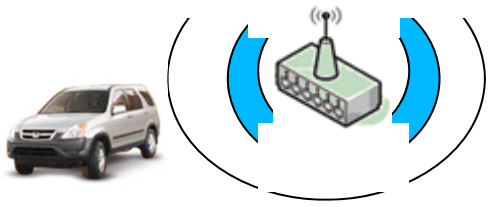
# Experimental results

- Interested in maximum throughput of the mobile advertisement application
- Scenario: 1 AP, cars moving relatively constant
- If congestions would be used, cars stay longer in the wireless transmission range… this is why we expect in real-world to have better results



# Explanation

- Consider a 112 KB message
- Sending it requires the use of 459 frames (112 KB / 250 B)
- The beacon interval is 10 ms.
- Therefore, sending 459 frames requires 4.59 seconds.
- Each vehicle moving at 70 Km/h traverses the wireless transmission range of an AP (90 m) in maximum 4.6 seconds (90 m / 70 Km/h).
- Therefore, it takes a vehicle *4.6 seconds* to reach the AP, but it takes a message *4.59 seconds* to be completely sent.
- No room for packet losses…



# Conclusions

- Mobile advertisement provides vehicles on the road with advertisement information related to their current location.
  - Traditional billboards on the carrier
- Utility to business companies and municipalities who wants to dynamically advertise events, products to more people
- For the driver is also easy to filter out information – possible topic-based approach, or the driver's interests and intents learned or discovered using social techniques ← next step
- Extension for VNSim's simulator
  - Easily evaluated by extended the traffic mobility and network models to incorporate the proposed application
- Results show that it is feasible
  - People can more easily disseminate and find out information using location, the existing road infrastructure and wireless technologies

# Acknowledgements

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# Q&A

Thank you!